PB-240 301

NEST LAKE, KANDIYOHI COUNTY, MINNESOTA

Pacific Northwest Environmental
Research Laboratory

Prepared for:

National Environmental Research Center
Minnesota Pollution Control Agency
Minnesota National Guard

November 1974

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT
ON
NEST LAKE
KANDIYOHI COUNTY
MINNESOTA
EPA REGION V
WORKING PAPER No. 117

WITH THE COOPERATION OF THE
MINNESOTA POLLUTION CONTROL AGENCY
AND THE
MINNESOTA NATIONAL GUARD

NOVEMBER, 1974

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Minnesota Pollution Control Agency for professional involvement and to the Minnesota National Guard for conducting the tributary sampling phase of the Survey.

Grant J. Merritt, Director of the Minnesota Pollution Control Agency, John F. McGuire, Chief, and Joel G. Schilling, Biologist, of the Section of Surface and Groundwater, Division of Water Quality, provided invaluable lake documentation and counsel during the course of the Survey; and the staff of the Section of Municipal Works, Division of Water Quality, were most helpful in identifying point sources and soliciting municipal participation in the Survey.

Major General Chester J. Moeglein, the Adjutant General of Minnesota, and Project Officer Major Adrian Beltrand, who directed the volunteer efforts of the Minnesota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

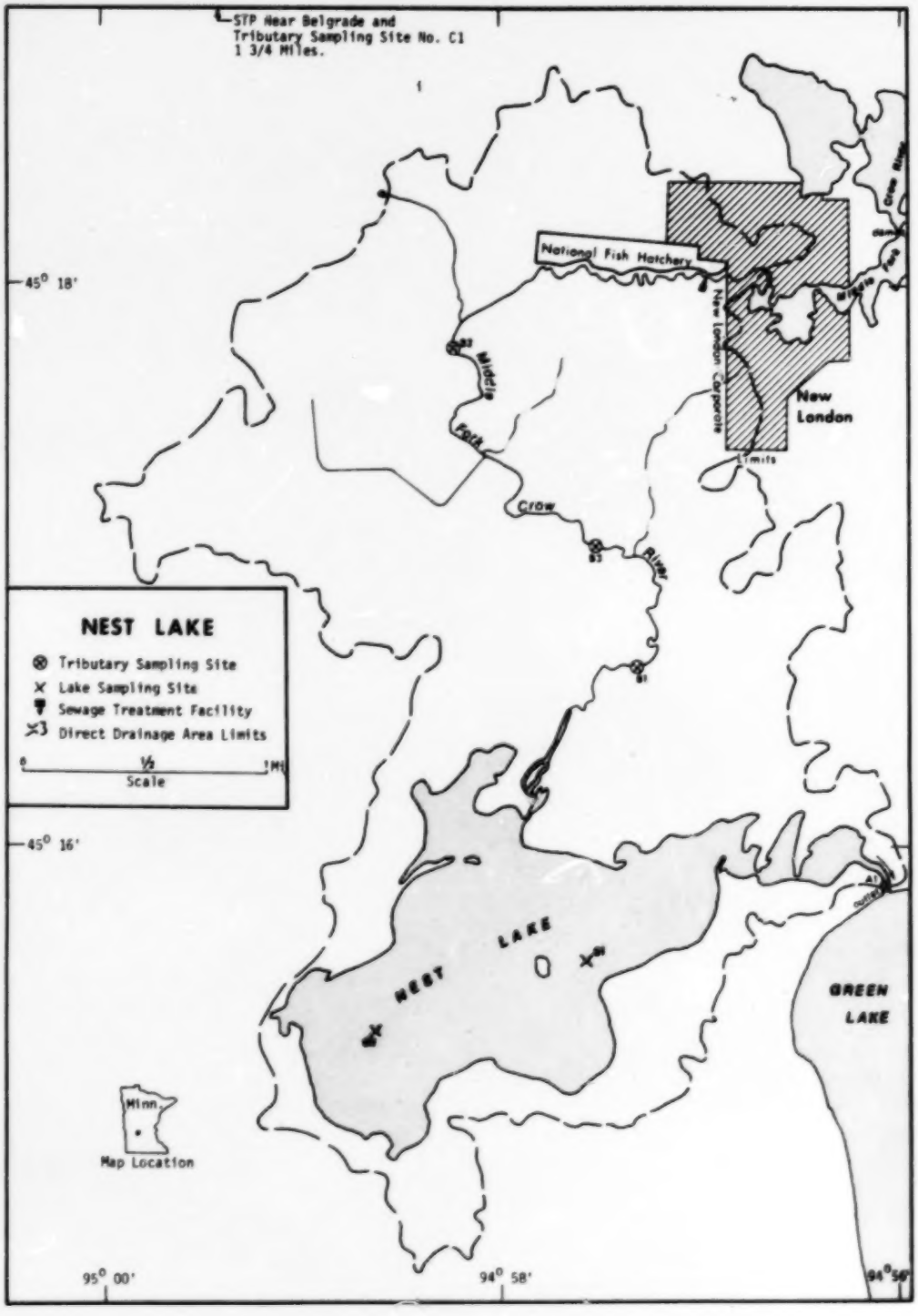
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MINNESOTA

LAKE NAME	COUNTY
Albert Lea	Freeborn
Andrusia	Beltrami
Badger	Polk
Bartlett	Koochiching
Bear	Freeborn
Bemidji	Beltrami
Big	Stearns
Big Stone	Big Stone, MN; Roberts, Grant, SD
Birch	Cass
Blackduck	Beltrami
Blackhoof	Crow Wing
Budd	Martin
Buffalo	Wright
Calhoun	Hennepin
Carlos	Douglas
Carrigan	Wright
Cass	Beltrami, Cass
Clearwater	Wright, Stearns
Cokato	Wright
Cranberry	Crow Wing
Darling	Douglas
Elbow	St. Louis
Embarass	St. Louis
Fall	Lake
Forest	Washington
Green	Kandiyohi
Gull	Cass
Heron	Jackson
Leech	Cass
Le Homme Dieu	Douglas
Lily	Blue Earth
Little	Grant
Lost	St. Louis

LAKE NAME	COUNTY
Madison	Blue Earth
Malmedal	Pope
Mashkenode	St. Louis
McQuade	St. Louis
Minnetonka	Hennepin
Minnewaska	Pope
Mud	Itasca
Nest	Kandiyohi
Pelican	St. Louis
Pepin	Goodhue, Wabasha, MN; Pierce, Pepin, WI
Rabbit	Crow Wing
Sakatah	Le Sueur
Shagawa	St. Louis
Silver	McLeod
Six Mile	St. Louis
Spring	Washington, Dakota
St. Croix	Washington, MN; St. Croix, Pierce, WI
St. Louis Bay	St. Louis, MN; Douglas, WI
Superior Bay	St. Louis, MN; Douglas, WI
Swan	Itasca
Trace	Todd
Trout	Itasca
Wagonga	Kandiyohi
Wallmark	Chisago
White Bear	Washington
Winona	Douglas
Wolf	Beltrami, Hubbard
Woodcock	Kandiyohi
Zumbro	Olmstead, Wabasha


STP Near Belgrade and
Tributary Sampling Site No. C1
1 3/4 Miles.
National Fish Hatchery
New London Corporate Limits
New London
Middle Fork Crow River
NEST LAKE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Direct Drainage Area Limits
0
½
1 Mi
Scale
45° 18'
45° 16'
95° 00'
94° 58'
94° 56'
NEST LAKE
GREEN LAKE
Minn.
Map Location

NEST LAKE

STORET NO. 27B3

I. CONCLUSIONS

A. Trophic Condition:

Survey data show that Nest Lake is eutrophic. Of the 60 Minnesota lakes sampled in the fall when essentially all were well-mixed, 25 had less mean total phosphorus, and 16 had less mean inorganic nitrogen. For all 80 lakes sampled, 46% had greater transparency, and 59% had less mean chlorophyll a. Depression and near depletion of dissolved oxygen with depth occurred in early August and late August of 1972.

Survey limnologists observed an algal bloom in progress in August; and, reportedly, Nest Lake has been chemically treated for control of both algae and rooted aquatic vegetation (Bonnema and Johnson, 1972).

B. Rate-Limiting Nutrient:

Algal assay results show that Nest Lake was nitrogen limited at the time the assay sample was collected. Lake data show nitrogen limitation at the other sampling times as well (N/P ratios were less than 10/1).

C. Nutrient Controllability:

1. Point sources--During the sampling year, Nest Lake received a total phosphorus load at a rate in excess of that

proposed by Vollenweider (in press) as "dangerous"; i.e., a eutrophic rate (see page 13). Of this load, it is estimated that the communities of Belgrade and New London, collectively, contributed about 57% (it is assumed that all of the P load from Belgrade reached Nest Lake, although a sizable nutrient trap--Mud Lake near New London--lies between the STP and Nest Lake).

It is calculated that 80% phosphorus removal at the two point sources would reduce the loading rate to 0.43 $g/m^2/yr$ or less than a "dangerous" rate, and it is concluded that phosphorus control at Belgrade and New London would result in improvement of the trophic condition of Nest Lake as well as the condition of downstream Green Lake.

2. Non-point sources (see page 13)--The phosphorus export of the Middle Fork of the Crow River during the sampling year (23 $lbs/mi^2/yr$) was very similar to the mean phosphorus export of four unimpacted streams tributary to nearby Big Stone Lake (19 $lbs/mi^2/yr$).

In all, non-point sources are estimated to have contributed about 42% of the total phosphorus load to Nest Lake during the sampling year.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry†:

1. Surface area: 945 acres.
2. Mean depth: 15 feet.
3. Maximum depth: 40 feet.
4. Volume: 14,175 acre/feet.
5. Mean hydraulic retention time: 190 days.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage Area*	Mean flow*
Middle Fork, Crow River	115.0 mi^2	35.1 cfs
Minor tributaries & immediate drainage -	6.7 mi^2	2.5 cfs
Totals	121.7 mi^2	37.6 cfs

2. Outlet -

Green Lake inlet	123.0 mi^2**	37.6 cfs

C. Precipitation***:

1. Year of sampling: 28.1 inches.
2. Mean annual: 24.5 inches.

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† DNR survey map (1970); mean depth by planimetry.
* Drainage areas are accurate within ±5%; mean daily flows are accurate within ±10%; and ungaged flows are accurate within ±10 to 25% for drainage areas greater than 10 mi^2.
** Includes area of lake.
*** See Working Paper No. 1, "Survey Methods".

III. LAKE WATER QUALITY SUMMARY

Nest Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two stations on the lake and from two or more depths at each station (see map, page vi). During each visit, a single depth-integrated (15 feet to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the last visit, a single five-gallon depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 24 feet at station 1 and 20 feet at station 2.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake was essentially well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

Parameter	Minimum	Mean	Median	Maximum
		FALL VALUES (10/25/72)		
Temperature (Cent.)	6.4	6.6	6.6	6.8
Dissolved oxygen (mg/l)	9.4	10.2	10.0	11.8
Conductivity (μmhos)	345	354	355	360
pH (units)	8.3	8.4	8.4	8.5
Alkalinity (mg/l)	188	191	191	192
Total P (mg/l)	0.035	0.044	0.042	0.057
Dissolved P (mg/l)	0.021	0.025	0.025	0.029
NO_2 + NO_3 (mg/l)	0.020	0.070	0.030	0.360
Ammonia (mg/l)	0.060	0.126	0.085	0.450
		ALL VALUES		
Secchi disc (inches)	36	54	48	78

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
07/02/72	1. Microcystis	1,609
	2. Dinobryon	560
	3. Anabaena	506
	4. Flagellates	307
	5. Melosira	235
	Other genera	609
	Total	3,725
08/31/72	1. Microcystis	3,454
	2. Ceratium	778
	3. Lyngbya	488
	4. Anabaena	470
	5. Dinobryon	416
	Other genera	1,410
	Total	7,016
10/25/72	1. Flagellates	2,940
	2. Dinobryon	729
	3. Melosira	427
	4. Oscillatoria	201
	5. Chroococcus	151
	Other genera	1,130
	Total	5,578

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
07/02/72	01	5.0
	02	3.9
08/31/72	01	31.1
	02	39.5
10/25/72	01	26.2
	02	22.9

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.021	0.090	3.8
0.005 P	0.026	0.090	3.7
0.010 P	0.031	0.090	3.8
0.020 P	0.041	0.090	3.6
0.050 P	0.071	0.090	3.7
0.050 P + 10.0 N	0.071	10.090	28.9
10.0 N	0.021	10.090	7.2

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Nest Lake was moderately high at the time the sample was collected. Also, the lack of significant change in yields with increased levels of orthophosphorus, until nitrogen was also added, indicates that the lake was nitrogen limited

when sampled. Note that the addition of only nitrogen resulted in a yield significantly larger than the control yield.

Nitrogen limitation is also indicated by the lake data each sampling time; i.e., all nitrogen to phosphorus ratios were less than 10 to 1.

IV. NUTRIENT LOADINGS
(See Appendix C for all data)

For the determination of nutrient loadings, the Minnesota National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi), except for the high runoff month of May when two samples were collected, and the colder months when one or more samples were omitted at three stations because of low flows. Sampling was begun in October, 1972, and was completed in September, 1973.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Minnesota District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loadings for unsampled "minor tributaries & immediate drainage" ("ZZ" of U.S.G.S.) were estimated by using the means of the nutrient loads, in lbs/mi^2/year, in streams tributary to nearby Big Stone Lake at stations 2709D-1, E-1, F-1, and G-1 and multiplying the means by the Nest Lake ZZ area in mi^2.

The operator of the Belgrade wastewater treatment plant provided monthly effluent samples and corresponding flow data; however, the Village of New London declined participation in the Survey, and loads were estimated at 2.5 lbs P and 7.5 lbs N/capita/year.

Nutrient loads attributed to tributaries are those measured minus point-source loads, if any.

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* See Working Paper No. 1.

A. Waste Sources:

1. Known municipal -

Name	Pop. Served*	Treatment	Mean Flow (mgd)	Receiving Water
Belgrade	713	act. sludge	0.131	Middle Fork, Crow River
New London	736	prim. clarifier	0.129**	Middle Fork, Crow River

2. Known industrial** -

Name	Treatment	Mean Flow (mgd)	Receiving Water
New London Creamery Assoc.	New London STP	?	(Crow River)
Gordhammer's Food Mkt.	Belgrade STP	?	(Crow River)
Farmer's Coop. Assoc.	Belgrade STP	?	(Crow River)
Engwall Bros. Locker, Spicer	septic tank & soil absorb.	?	no discharge

* 1970 Census.
** Beaton & McGuire, 1969.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
Middle Fork, Crow River	2,590	38.5
b. Minor tributaries & immediate drainage (non-point load) -	130	1.9
c. Known municipal -		
Belgrade	2,020	30.1
New London	1,840	27.4
d. Septic tanks - Unknown	-	-
e. Known industrial - (to municipal STP's)		-
f. Direct precipitation* -	140	2.1
Total	6,720	100.0

2. Outputs -

Lake outlet - to Green Lake 2,930

3. Net annual P accumulation - 3,790 pounds

* See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/ yr	% of total
a. Tributaries (non-point load) -		
Middle Fork, Crow River	116,410	84.1
b. Minor tributaries & immediate drainage (non-point load) -	2,470	1.8
c. Known municipal -		
Belgrade	4,910	3.5
New London	5,520	4.0
d. Septic tanks - Unknown	-	-
e. Known industrial - (to municipal STP's)		-
f. Direct precipitation* -	9,100	6.6
Total	138,410	100.0

2. Outputs -

Lake outlet - to Green Lake 116,470

3. Net annual N accumulation - 21,940 pounds

* See Working Paper No. 1.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	lbs $P/mi^2/yr$	lbs $N/mi^2/yr$
Middle Fork, Crow River	23	1,012

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving waters would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

	Total Phosphorus		Total Nitrogen	
Units	Total	Accumulated	Total	Accumulated
lbs/acre/yr	7.1	4.0	146.5	23.2
grams/m^2/yr	0.80	0.45	16.4	2.6

Vollenweider loading rates for phosphorus ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Nest Lake:

"Dangerous" (eutrophic rate)	0.58
"Permissible" (oligotrophic rate)	0.29

V. LITERATURE REVIEWED

Anonymous, 1973. Wastewater disposal facilities inventory. MPCA, Minneapolis.

Beaton, Perry T., and John F. McGuire, 1969. Report memorandum on water quality of Green Lake, Kandiyohi County. MPCA, Minneapolis.

Bonnema, Kenneth, and William G. Johnson, 1972. Control of aquatic vegetation, algae, leeches, and swimmer's itch. MN Dept. Nat. Resources, Minneapolis.

Schilling, Joel, 1974. Personal communication (lake map). MPCA, Minneapolis.

Vollenweider, Richard A., (in press). Input-output models. Schweiz. A. Hydrol.

VII. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR MINNESOTA 10/30/74

LAKE CODE 2743 WEST LAKE

TOTAL DRAINAGE AREA OF LAKE 123.00

TRIBUTARY	SUB-DRAINAGE AREA	NORMALIZED FLOWS JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
279341	123.00	13.70	14.40	25.00	64.40	86.70	80.50	56.60	33.90	26.00	18.30	15.10	15.80	37.63
279341	115.00	13.00	13.60	23.50	59.90	80.40	75.00	52.80	31.60	24.20	16.90	14.00	14.90	35.10
279327	8.19	0.67	0.84	1.27	3.96	6.11	6.70	4.12	1.79	1.89	1.33	0.96	0.83	2.53

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 123.00
SUM OF SUB-DRAINAGE AREAS = 123.19
TOTAL FLOW IN = 450.45
TOTAL FLOW OUT = 450.40

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
279341	10	72	49.10	15	46.00				
	11	72	64.40	3	61.00				
	12	72	45.60	9	51.00				
	1	73	49.50	6	50.00				
	2	73	39.50	6	42.00				
	3	73	58.40	10	59.00				
	4	73	114.00	14	115.00				
	5	73	95.80	6	93.00	19	87.00		
	6	73	52.10	10	66.00				
	7	73	14.40	14	19.00				
	8	73	26.00	11	23.10				
	9	73	13.50	6	22.40				
279341	10	72	45.80	15	43.00				
	11	72	60.10	3	57.00				
	12	72	43.00	9	48.00				
	1	73	46.90	6	47.00				
	2	73	37.30	6	40.00				
	3	73	92.40	10	56.00				
	4	73	108.00	14	107.00				
	5	73	88.30	6	87.00	19	82.00		
	6	73	48.40	10	62.00				
	7	73	15.10	14	17.75				
	8	73	24.30	11	21.60				
	9	73	12.60	6	21.30				
279327	10	72	3.61	15	3.40				
	11	72	4.11	3	3.90				
	12	72	2.34	9	2.70				
	1	73	2.42	6	2.40				
	2	73	1.75	6	1.90				
	3	73	5.82	10	3.80				
	4	73	6.47	14	7.00				
	5	73	6.72	6	6.40	19	4.20		
	6	73	4.34	10	5.50				
	7	73	1.19	14	1.38				
	8	73	1.38	11	1.23				
	9	73	0.93	6	1.60				

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APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/10/30

27B301
45 15 36.0 094 57 35.0
NEST LAKE
27 MINNESOTA

11EPALES 2111202
3 0022 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/07/02	17 40	0000	23.0	10.6	48	330	8.30	200	0.030	0.050	0.034	0.012
	17 40	0020	18.1	2.0		395	7.70	216	0.030	0.100	0.029	0.011
72/08/31	14 55	0000			39	328	8.30	168	0.090	0.260	0.033	0.023
	14 55	0004	20.8	7.6		325	8.32	169	0.110	0.130	0.034	0.024
	14 55	0015	20.7	8.4		380	8.30	172	0.060	0.300	0.039	0.032
	14 55	0024	18.2	0.8		440	7.30	192	0.120	0.880	0.253	0.130
72/10/25	15 00	0000			78	360	8.50	190	0.360	0.090	0.040	0.029
	15 00	0004	6.9	10.0		345	8.50	190	0.030	0.060	0.049	0.027
	15 00	0015	6.7	10.0		345	8.40	192	0.020	0.040	0.042	0.022
	15 00	0019	6.7	10.4		350	8.40	192	0.030	0.050	0.040	0.021

81

DATE FROM TO	TIME OF DAY	DEPTH FEET	32211 CHLRPHYL A UG/L
72/07/02	17 40	0000	5.0J
72/08/31	14 55	0000	31.1J
72/10/25	15 00	0000	26.2J

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/10/30

27H302
45 15 20.0 094 58 40.0
NEST LAKE
27 MINNESOTA

11EPALES 2111202
3 0024 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/07/02	18 30	0000	22.5	9.2	48	320	8.20	230	0.040	0.060	0.022	0.011
	18 30	0020	18.0	1.4		380	7.70	170	0.040	0.020	0.033	0.013
72/08/31	13 15	0000			36	328	8.10	171	0.100	0.120	0.040	0.024
	13 15	0004	20.2	6.2		338	8.10	172	0.040	0.060	0.061	0.017
	13 15	0015	20.2	6.8		335	8.10	174	0.040	0.060	0.043	0.017
	13 15	0020	19.8	4.8		335	7.88	174	0.080	0.160	0.029	0.019
72/10/25	15 15	0000			72	350	8.30	188	0.030	0.050	0.042	0.021
	15 15	0004	6.5	9.4		360	8.40	191	0.040	0.060	0.035	0.023
	15 15	0015	6.5	9.6		360	8.40	190	0.020	0.040	0.044	0.027
	15 15	0020	6.4	11.8		360	8.40	192	0.030	0.060	0.057	0.029

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/07/02	18 30	0000	3.9J
72/08/31	13 15	0000	39.6J
72/10/25	15 15	0000	22.9J

J VALUE KNOWN TO BE IN ERROR

APPENDIX C

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 74/10/30

27H3A1
45 16 00.0 094 56 00.0
NEST LK/GREEN LK CONNECTION
27 7.5 NEW LONDON
O/WEST LAKE
CO HWY 30 XING NNE OF SPICER
11FPALFS 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/15	11 30		0.093	1.680	0.120		0.039
72/11/03	13 55		0.020	0.840	0.054	0.007	0.032
72/12/09	10 20		0.078	0.950	0.072	0.010	0.021
73/01/06	11 45		0.066	1.150	0.110	0.019	0.025
73/02/04	11 15		0.126		0.220	0.017	0.045
73/03/10	13 00		0.230	0.900	0.023	0.013	0.037
73/04/14	09 30		0.025	2.100	0.005K	0.006	0.030
73/05/06	10 30		0.046	1.900	0.026	0.007	0.035
73/05/19	08 25		0.015	0.760	0.019	0.014	0.045
73/06/10	10 30		0.020	1.000	0.012	0.007	0.035
73/07/14	11 00			3.500	0.180	0.020	0.070
73/08/11	11 15		0.010K	1.200	0.033	0.017	0.045
73/09/06	20 05		0.027	4.000	0.370	0.017	0.055

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

```
 27H3R1          LS27H3R1
45 17 30.0 094 57 39.0
MIDDLE FORK CROW RIVER
27       7.5 NEW LONDON
WEST LAKE
RM 06 .75 MI UPSTREAM FROM  LAKE
11PALES                    2111204
                           0000 FEET  DEPTH
```

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/15			0.126	1.900	0.115	0.010	0.052
72/11/03	13 45		0.110	1.200	0.098	0.021	0.052
73/02/04	11 00		0.158	2.400	0.290	0.016	0.040
73/03/10	13 30		0.168	1.200	0.220	0.027	0.070
73/04/14	09 40		0.058	2.100	0.100	0.013	0.036
73/05/06	10 45		1.020	0.420	0.066	0.005K	0.025
73/05/19	08 10		0.013	0.400	0.005K	0.029	0.074
73/06/10	10 25		0.052	1.320	0.044	0.040	0.075
73/07/14	10 30		0.170	3.000	0.108	0.087	0.140
73/08/11	10 50		0.300	1.050	0.044	0.092	0.170
73/09/06	21 10		0.335	2.600	0.230	0.189	0.290

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

274382 LS274382
45 17 30.0 094 58 00.0
MIDDLE FORK CROW RIVER
27 7.5 NEW LONDON
1/NEST LAKE
CO HWY 40 XING 1 MI W OF NEW LONDON
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/15	10 55		0.098	1.300	0.087	0.007	0.046
72/11/03	13 30		0.091	1.100	0.126	0.019	0.046
72/12/09	09 55		0.096	1.400	0.105	0.007	0.025
73/02/04	10 50		0.115	1.200	0.240	0.011	0.035
73/03/10	14 00		0.105	1.300	0.260	0.042	0.085
73/04/14	09 50		0.036	1.540	0.033	0.009	0.025
73/05/06	10 00		0.031	2.100	0.046	0.007	0.040
73/05/19	07 40		0.042	0.980	0.019	0.025	0.080
73/06/10	10 00		0.040	1.500	0.072	0.024	0.070
73/07/14	10 15		0.062	2.500	0.330	0.050	0.105
73/09/11	10 35		0.140	1.600	0.210	0.140	0.250
73/09/06	21 45		0.110	5.750	1.890	0.220	0.400

STORET RETRIEVAL DATE 74/10/30

27=383 LS27=383
45 15 00.0 094 56 30.0
MIDDLE FORK CROW RIVER
27 7.5 NEW LONDON
WEST LAKE
ST HWY 9 BRDG IN NEW LONDONAHOV STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/15	10 35		0.080	1.300	0.093	0.005K	0.033
72/11/03	13 20		0.072	1.050	0.147	0.006	0.022
72/12/09	09 45		0.080	1.000	0.096	0.005K	0.014
73/02/04	10 40		0.082	3.480	0.336	0.005K	0.020
73/03/10	13 45		0.083	1.150	0.251	0.007	0.045
73/04/14	10 00		0.012	0.670	0.005K	0.006	0.026
73/05/06	10 25		0.018	1.150	0.018	0.005K	0.025
73/05/19	07 50		0.010K	0.960	0.021	0.010	0.040
73/06/10	10 15		0.018	1.260	0.015	0.007	0.030
73/07/14	09 55		0.010K	1.930	0.062	0.019	0.035
73/08/11	10 15		0.010K	1.320	0.034	0.020	0.060
73/09/06	21 00		0.023	2.400	0.273	0.031	0.069

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

27B3C1 LS27B3C1
45 25 30.0 094 59 30.0
STRM FLOWING SE TO MID FORK CROW
27 7.5 GEORGEVILLE
T/NEST LAKE
4ROG SSE OF HELGRADE BELO STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/15	10 15		1.040	1.000	0.189	0.017	0.180
72/11/03	13 00		0.998	1.100	0.160	0.022	0.200
72/12/09	09 20		1.200	1.260	0.336	0.032	0.180
73/01/06	10 50		1.620	1.150	0.252	0.032	0.185
73/02/04	10 15		1.240	2.400	0.320	0.043	0.250
73/03/10	13 00		1.220	1.290	0.270	0.115	0.345
73/04/14	10 20		0.570	3.300	0.215	0.037	0.190
73/05/06	09 50		0.570	2.730	0.190	0.022	0.170
73/05/19	07 20		0.730	0.890	0.115	0.038	0.280
73/06/10	09 40		0.990	1.050	0.270	0.028	0.220
73/07/14	09 45		1.720	2.500	0.380	0.036	0.180
73/08/11	09 30		1.520	0.900	0.240	0.030	0.140
73/09/06	21 51		1.300	1.900	0.250	0.029	0.240

STORET RETRIEVAL DATE 74/10/30

274351 AS278351 P000713
45 25 30.0 094 59 30.0
BELGRADE
27 7.5 GEORGEVILLE
T/NEST
UNNAMED STREAM
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/01/18	11	00							
CP(T)-			5.100	5.200	0.130	5.400	5.400	0.104	0.110
73/01/18	13	00							
73/02/27	12	00	1.050	11.500	0.010	5.900	7.600	0.173	0.173
73/03/30	11	00	3.100	18.000	0.005K	4.750	7.700	0.175	0.170
73/04/30	11	00	0.850	13.400		4.700	7.400	0.130	0.130
73/05/30	11	00	1.832	2.900	0.160	4.100	4.700	0.110	0.120
73/06/20	11	20	0.056	3.150	0.042	0.370	2.200	0.100	0.140
73/07/25	09	00	0.190	1.300	0.290	2.400	3.750	0.120	0.120
73/08/29	13	10		8.700	0.730	3.920	4.600	0.137	0.120
73/09/26	09	00	0.210	8.680	0.240	3.600	6.250	0.112	0.117
73/10/24	11	00	0.070	11.000	1.200	1.890	2.400	0.126	0.130
73/11/29	09	00	0.160	21.000	8.900	3.400	5.700	0.101	0.110
73/12/31	10	00	3.840	9.100	0.320	0.120	0.960	0.120	0.120
74/01/30	09	00	0.080	14.000	3.400	1.800	2.300	0.120	0.120

K VALUE KNOWN TO BE LESS THAN INDICATED